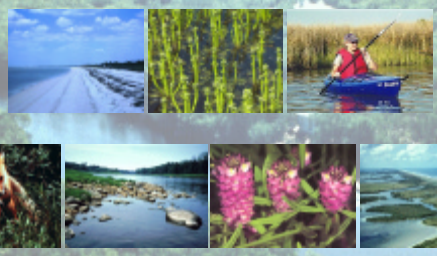
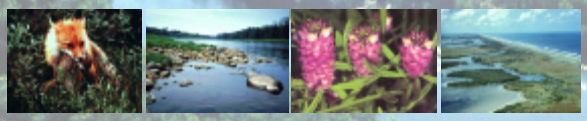
The Resource Lands Assessment Ecological Network





Chesapeake Bay Program

DCR Department of Conservation & Recreation

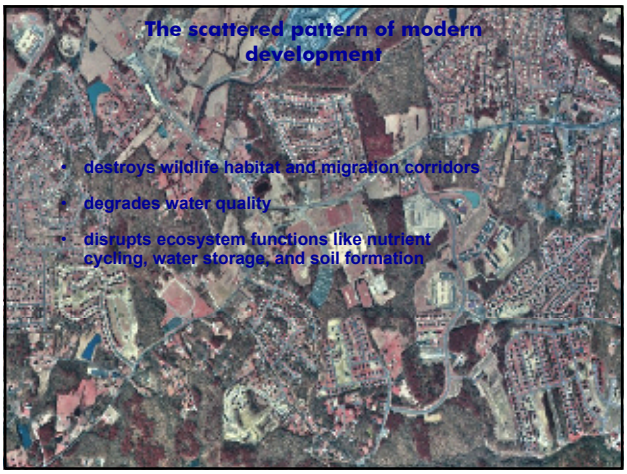
DCNR

Our vanishing rural areas

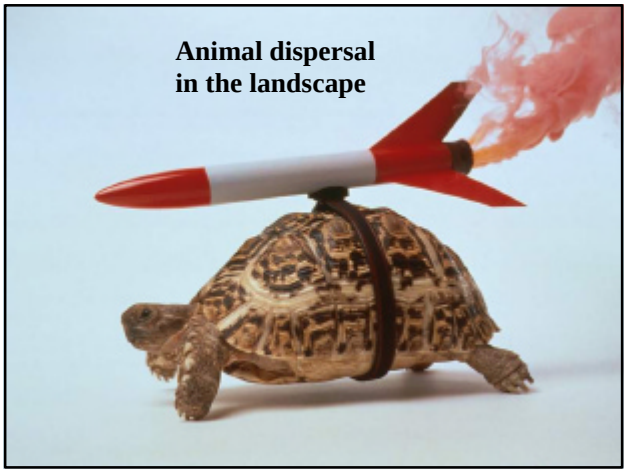
Streams with wide riparian buffers

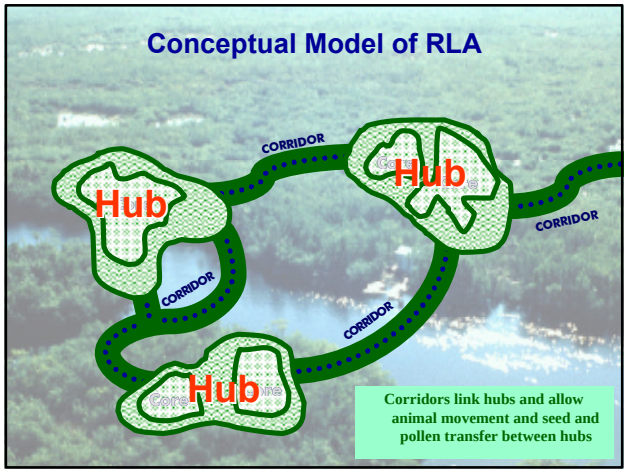
Large blocks of interior forest

Farms


The scattered pattern of modern development
• destroys wildlife habitat and migration corridors
• degrades water quality
• disrupts ecosystem functions like nutrient cycling, water storage, and soil formation


As forests and wetlands are divided and isolated:
• interior habitat decreases
• human disturbance increases
• opportunistic edge species replace interior species
• genetic exchange decreases
• populations of many species become too small to persist


Animal dispersal in the landscape


Conceptual Model of RLA
CORRIDOR
Hub
Hub
CORRIDOR
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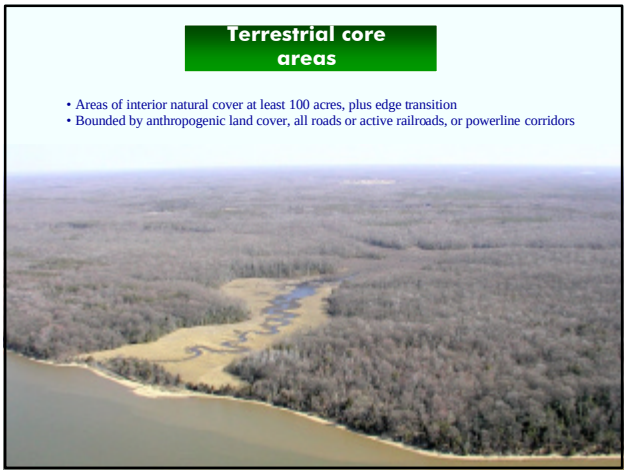
Hub
Corridors link hubs and allow animal movement and seed and pollen transfer between hubs


Terrestrial core areas
• Areas of interior natural cover at least 100 acres, plus edge transition
• Bounded by anthropogenic land cover, all roads or active railroads, or powerline corridors


Wetland core areas
Terrestrial core areas with:
• at least 50% wetland in its interior,
• or containing at least 100 ac if unmodified wetlands.

Upland core areas

Terrestrial core areas either:
- not designated as wetland core areas,
- with at least 50% of its interior as upland forest,
- or with at least 100 ac of upland interior forest.

Some terrestrial core areas could be defined as both wetland and upland core areas.

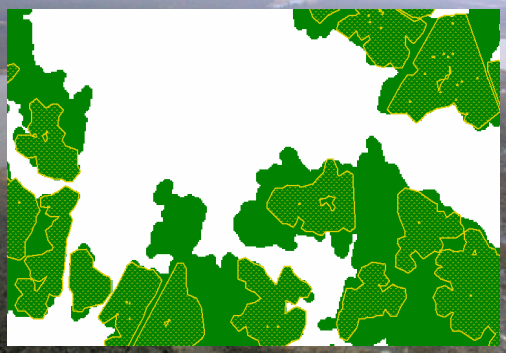
Aquatic core areas

HUC-11 watersheds having:
- <10% impervious surface,
- >2/3 forest cover,
- >2/3 forested or marsh stream banks,
- and no acid mine drainage.

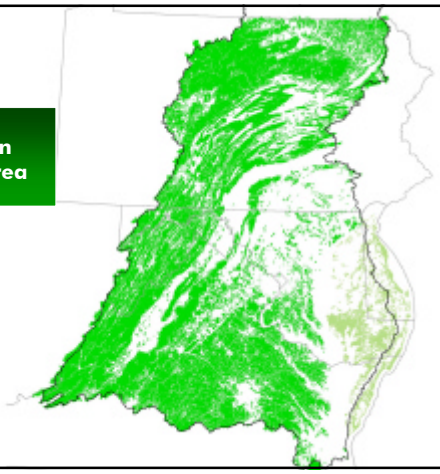
Hubs are:

- natural areas containing one or more core areas
- bounded by major roads and unsuitable land cover greater than 100 meters across

Hubs with Cores Highlighted



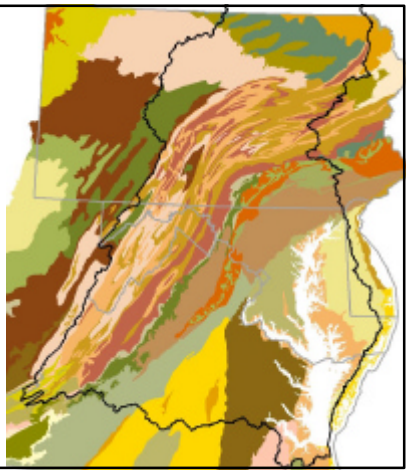
Hubs in study area



Omernik Ecoregions

Ecoregions = areas of relative homogeneity in ecological systems and their components (Woods et al, 1999)

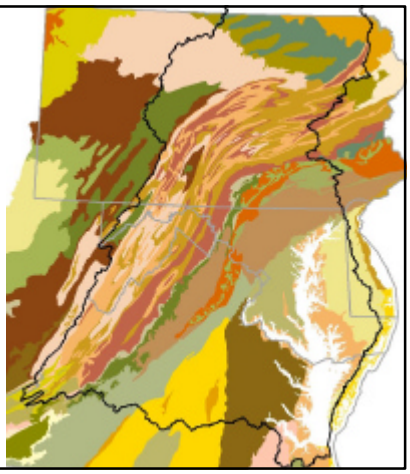
Ecological regions identified by analyzing the patterns and composition of biotic and abiotic phenomena that affect or reflect differences in ecosystem quality and integrity (Woods et al, 1999)



Omernik Ecoregions

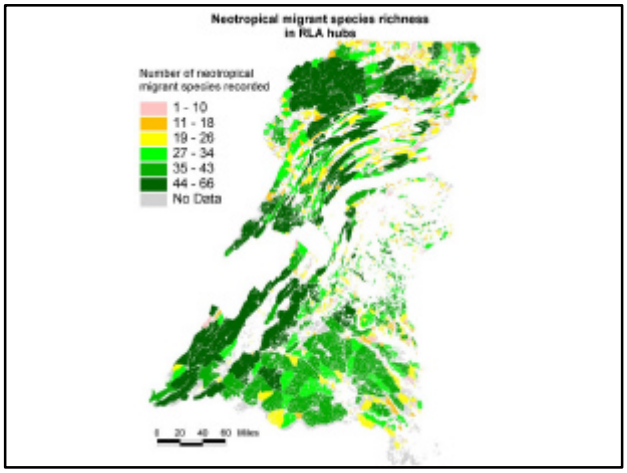
Based on:

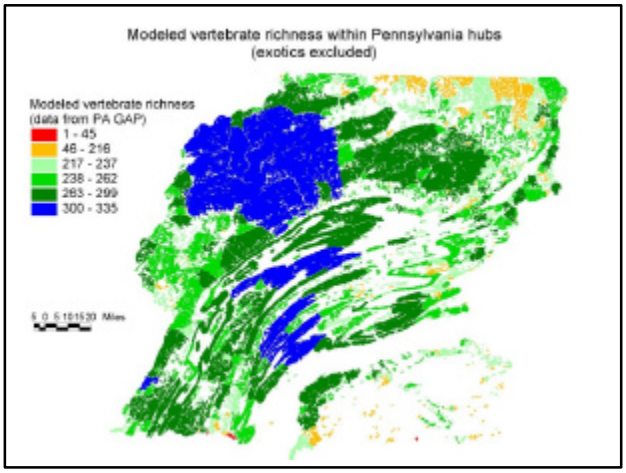
- climate
- elevation
- land use/land cover
- land form
- potential natural vegetation
- soil
- structural/bedrock geology
- surficial/Quaternary geology

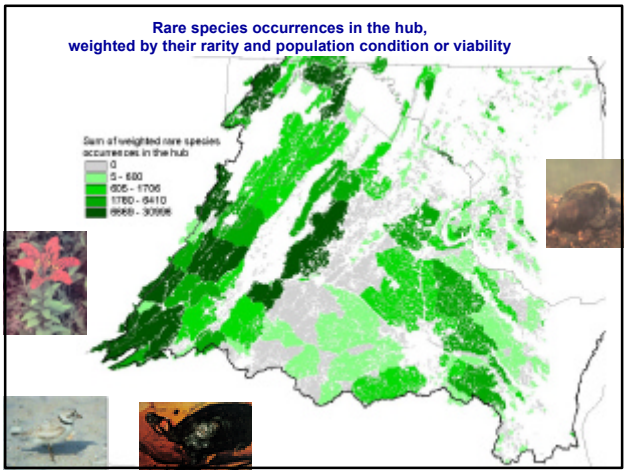


Hub ranking procedure:

1. Give each hub a unique ID
2. Identify majority ecoregion of each hub
3. Calculate parameters for each hub (percent core area, acres of interior forest, acres of wetlands, number of neotropical migrant species, etc.)







More hub ranking parameters:

- Amount of interior forest
- Vegetation maturity
- Plant community richness
- Topographic variability
- Number of soil types

- Wetland area
- Number of wetland types

- Length of streams within interior forest
- Number of stream sources and junctions

More hub ranking parameters:

- Hub intactness
- Remoteness from roads
- Nature of the surrounding landscape

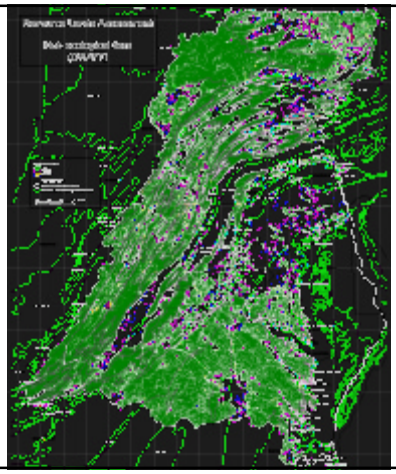
Hub ranking procedure (cont.):

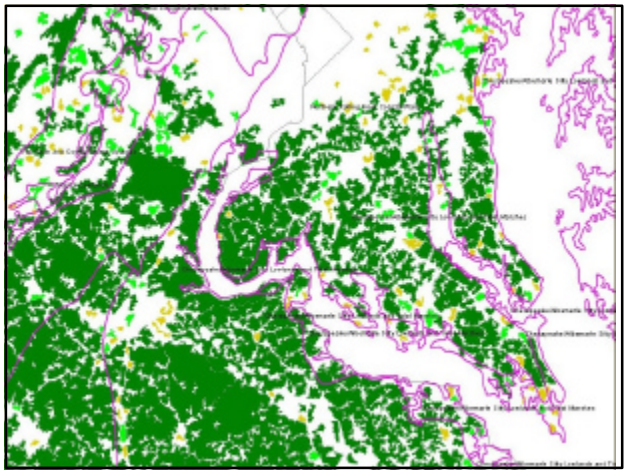
4. Test variables for correlation
5. Compare variables for predictability vs. Maryland Green Infrastructure
6. Choose RLA hub parameters, considering:
   a. Correlation with Green Infrastructure hub ranking
   b. Parameter biological importance
   c. Inter-parameter correlation
   d. Spatial overlap
   e. Modeling using All Possible Regressions (Hintze, 2001).
7. Weight parameters by their ecological importance, correlation with Green Infrastructure rankings, importance in APR models, and data reliability.
8. Rank hubs from best to worst for each parameter
   a. Within ecoregion
   b. Within entire study area

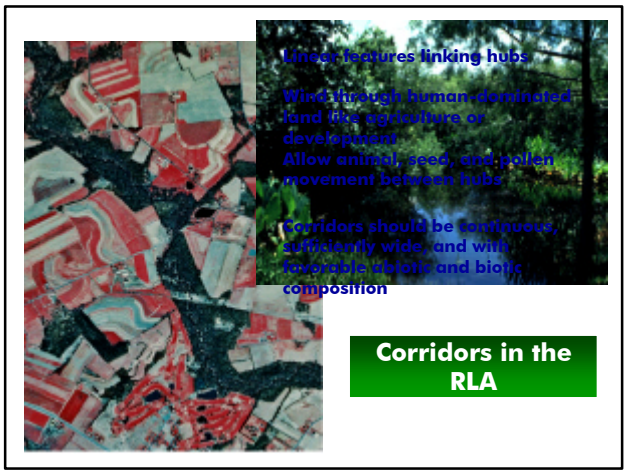
Variable	Variable description	Weight
EO_WT_SUM	Rare species occurrences in the hub, weighted by their rarity and population condition or viability (MD and VA only)	8 in MD, 5 in VA?
TOTALVERTS	Number of native vertebrate species modeled in the hub (PA only)	8
VA_MAXVERT	Number of native vertebrate species modeled in the hub (VA only)	3?
TOT_NEOTRP	Number of neotropical migrant bird species in the hub	4
UPINTFORAC	Area of upland interior forest (ac)	4
WTINTFORAC	Area of wetland interior forest (ac)	4
OTHERWETAC	Area of other wetlands (ac)	3
IFSTRM_KM	Length of streams within interior forest in the hub (km)	4
VEGSUCCLSS	Fraction of the hub in mature and natural vegetation communities	4
NUM_ECOREG	Number of ecoregions in the hub	2
GAP_TYPES	Number of GAP vegetation types in the hub	1
WETL_TYPES	Number of NWI wetland types	2
STRM_NODES	Numer of stream sources and junctions	1
ELEV_STD	Topographic relief (standard deviation of elevation) in the hub	1
SOIL_GRPS	Number of STATSGO soil types	1
INTNAT_PCT	% of interior natural area in the hub	4
MAJRD_DIST	Mean distance to nearest major roads (m)	2
PAVERDDIST	Mean distance to nearest paved road (m)	2
RDRAILDIST	Mean distance to nearest paved road, unpaved road, railway, or VA powerline (m)	1
-NEARESTHUB	Distance to nearest neighboring hub, transformed by multiplying by -1 (m)	2
FORAC_1KM	Acres of forest outside the hub, but within 1 km	2
WETAC_1KM	Acres of unmodified wetlands outside the hub, but within 1 km	2
CORE_1KM	Acres of core area outside the hub, but within 1 km	2
FORAC10KM	Acres of forest outside the hub, but within 10 km	1
WETAC10KM	Acres of unmodified wetlands outside the hub, but within 10 km	1
CORE_10KM	Acres of core area outside the hub, but within 10 km	1
HUBPCT10KM	% hub area outside the hub, but within 10 km	1

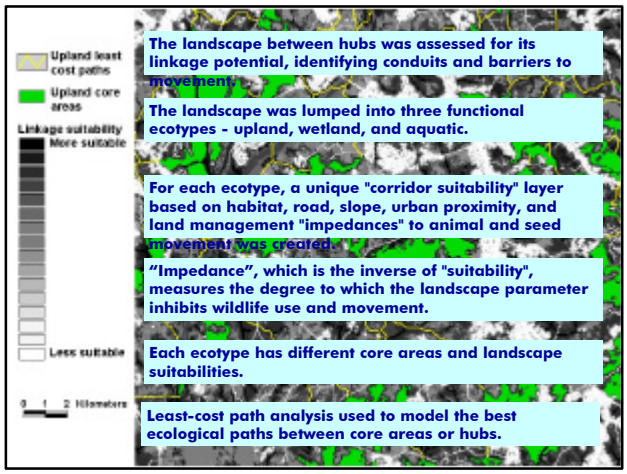
Hub ranking procedure (cont.):

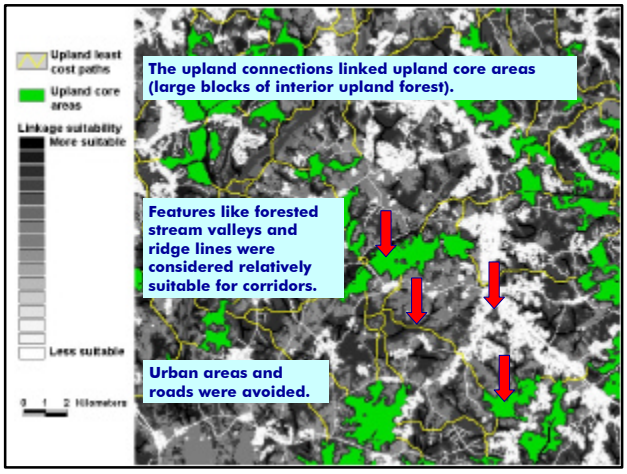
9. Hubs ranking in the top third (by quantile, not area) either within their ecoregion, or within the entire study area, were designated "top tier" hubs.
10. Hubs ranking in the middle third within their ecoregion were designated "middle tier" hubs.
11. Hubs ranking in the bottom third within their ecoregion were designated "bottom tier" hubs.

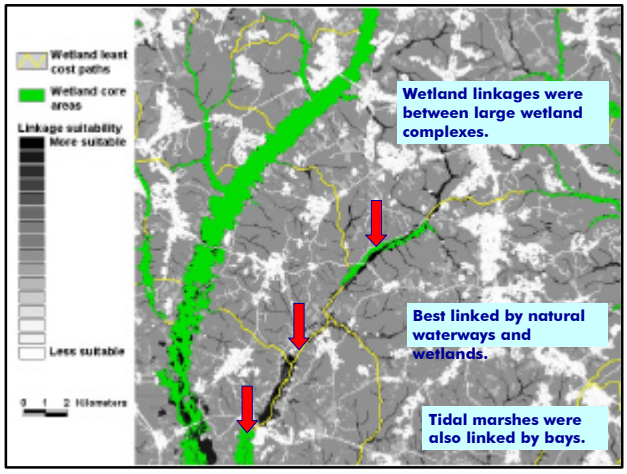


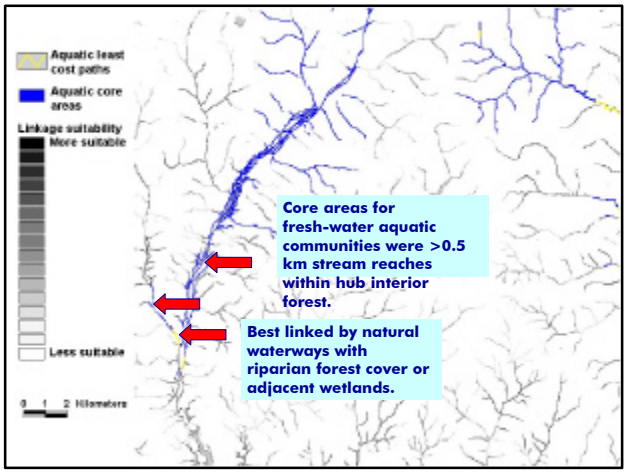


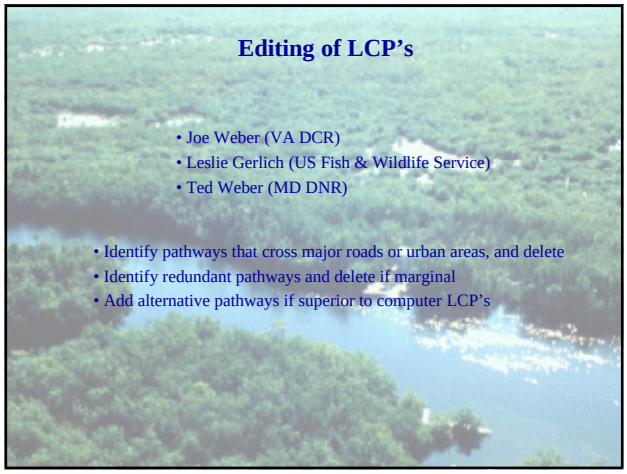

Linear features linking hubs
Wind through human-dominated land like agriculture or development
Allow animal, seed, and pollen movement between hubs
Corridors should be continuous, sufficiently wide, and with favorable abiotic and biotic composition
Corridors in the RLA


Upland least cost paths
Upland core areas
Linkage suitability
More suitable
Less suitable
The landscape between hubs was assessed for its linkage potential, identifying conduits and barriers to movement.
The landscape was lumped into three functional ecotypes - upland, wetland, and aquatic.
For each ecotype, a unique "corridor suitability" layer based on habitat, road, slope, urban proximity, and land management "impedances" to animal and seed movement was created.
"Impedance", which is the inverse of "suitability", measures the degree to which the landscape parameter inhibits wildlife use and movement.
Each ecotype has different core areas and landscape suitabilities.
Least-cost path analysis used to model the best ecological paths between core areas or hubs.


Upland least cost paths
Upland core areas
Linkage suitability
More suitable
Less suitable
The upland connections linked upland core areas (large blocks of interior upland forest).
Features like forested stream valleys and ridge lines were considered relatively suitable for corridors.
Urban areas and roads were avoided.


Wetland least cost paths
Wetland core areas
Linkage suitability
More suitable
Less suitable
Wetland linkages were between large wetland complexes.
Best linked by natural waterways and wetlands.
Tidal marshes were also linked by bays.


Aquatic least cost paths
Aquatic core areas
Linkage suitability
More suitable
Less suitable
Core areas for fresh-water aquatic communities were >0.5 km stream reaches within hub interior forest.
Best linked by natural waterways with riparian forest cover or adjacent wetlands.

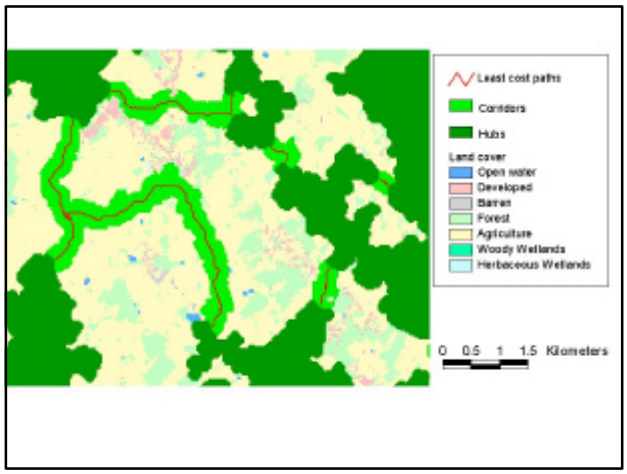

Editing of LCP's
• Joe Weber (VA DCR)
• Leslie Gerlich (US Fish & Wildlife Service)
• Ted Weber (MD DNR)
• Identify pathways that cross major roads or urban areas, and delete
• Identify redundant pathways and delete if marginal
• Add alternative pathways if superior to computer LCP's

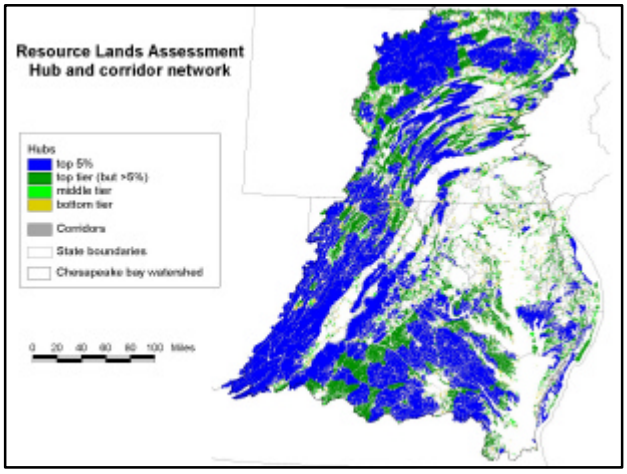
Corridor widths

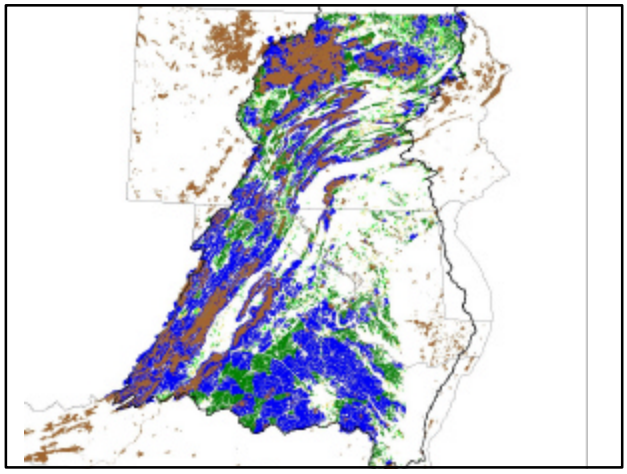
1. Buffer least cost paths a minimum 168 m on each side of the path, giving 135 m of interior conditions and 100 m of transition to edge on either side

2. If the LCP follows a stream, also include adjacent steep slopes

3. Add adjacent forest and wetland







Possible future steps:

1. Create finer-scale (cell-based) ecological ranking.
2. Integrate habitat model with other RLA data
3. Create and distribute maps and documents
4. Re-do model when better data is available.
   a. More recent land cover (e.g., RESAC)
   b. BCD data from PA and WV, and delineated habitat areas from MD, VA, etc.
   c. GAP vertebrate models for all states (umbrella species)
   d. Faster computers needed! (took four computers several days each to calculate LCP's)